Waubee Lake Report

Kosciusko County, Indiana

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A USEPA 314 grant-funded diagnostic/feasibility study was conducted for Waubee Lake, a 187-acre lake in 1982. The study revealed that two inlets, Felkner and Hammond ditches, contribute the majority of the lakes phosphorus input, even though the ditches pass through rather extensive wetland areas immediately before entering the lake. The Waubee Lake Association had applied for a Lake and River Enhancement (LARE) Grant in January of 2001 to evaluate the feasibility of further reducing phosphorus levels by implementing best management practices, but was not approved for funding. It was recommended by the LARE staff to seek assistance from local sources.

In August of 2001, Don Arnold, President of the Waubee Lake Association, came to the Kosciusko County Soil and Water Conservation District (SWCD) office to seek assistance in finding sources of nutrient and sediments problems in their lake and watershed. At the August 14, 2001 SWCD Board meeting, Don Arnold asked the Board for some assistance in addressing and improving the water quality in Waubee Lake. The Board asked Julie Harrold, IDNR Resource Specialist, to assist and investigate needs to improve the water quality of the lake.

The Waubee Lake Association's main concerns include nutrient and sediment loading that is occurring in the lake. The source of this loading needed to be researched to try to discover where it might be coming from. A decision was made to conduct some water testing at adequate access sites along the two main ditches that flow into Waubee Lake. A decision was also made to conduct an inventory of these two ditches and the adjacent landuse.

Surrounding Habitat and Tributaries

Waubee Lake is located in northern Kosciusko County near Milford, Indiana. It has two main tributaries/ditches that flow into the Lake on the Southeast side, Hammond and Felkner ditches. Hammond ditch enters Waubee Lake on the east to southeast side of the lake by Camp Alexander Mack. It originates approximately three (3) miles upstream at Dewart Lake. It flows through and drains approximately 2 miles of agricultural land before it enters a woodland about one (1) mile from the lake. It then flows from the woodland through a large wetland for about ½ mile before entering the lake.

Felkner ditch enters through a shallow channel in the southeast corner of the lake. It originates at the outlet of animal waste treatment ponds at Maple Leaf Duck Farms. It flows about two (2) stream miles through a marshy wetland before it enters the lake.

Waubee Lake is drained by an outflow on the northern side of the Lake. This outflow drains to Turkey Creek. The lake is surrounded on the Western and Northern sides by residential development, and the Northeastern side is utilized by Camp Alexander Mack. The Southeast side consists of undeveloped woodlands and wetlands. The entire watershed was not evaluated, just the area adjacent to the ditches.
(Refer to Figure 1).

Water Quality Testing

There were five (5) sites tested along Hammond ditch, and two (2) sites tested along Felkner ditch. The outlet of Waubee Lake was also tested.

(Refer to Figure 1 for the location of testing sites.) The seven sites located on the ditches were tested on December 5, 2001, February 21, 2002, and May 2, 2002. The tests done on the outlet were conducted on February 25, 2002 and May 2, 2002. (Refer to Tables 1a-1d for the results of the water testing.)

The tests were done with water monitoring kits known as Green Kits, made by the LaMotte Company, which gives Low, Medium, and High tests results in parts per million (ppm). There were three different tests conducted on the water samples taken; phosphate (PO_4), nitrate (NO_3), and pH. The water temperature at all the sites was between 20 – 25 C.

Description of Sites

1. The first site is on Hammond ditch at the lake located behind Camp Alexander Mack. The water sample used for the tests was taken from the middle of the stream just before it goes through the culvert under the bridge.
2. The second site is located on Hammond ditch at Mock Road. The water sample was taken from the main flow of the stream on the south side of the road at the culvert.
3. The third site is located on Hammond ditch at County Road 200E. The water sample was taken from the main flow of the stream on the east side of the road at the culvert.
4. The fourth site is located on Hammond ditch at County Road 250 E. The water sample was taken on the north side of the stream at the culvert on the east side of the dirt road.
5. The fifth site is located on Hammond ditch at County Road 300 E by Dewart Lake. The water sample was taken from the main stream flow at the culvert on the west side of the road. The water was flowing here at a fast rate.

6. The sixth site is located on Felkner ditch, at the lake, at the corner of County Road 100 E and Mock Road. The sample was taken from the stream on the west side of 100 E.
7. The seventh site is located on Felkner ditch at County Road 200 E by the Maple Leaf Dam. It is just downstream from the outflow control structure of the waste treatment ponds.
8. The eighth site is at the outlet of Waubee Lake located on the north side of the lake. The sample was taken in the main stream flow just as the lake empties into the stream on the south side of the bridge.

FIGURE 1

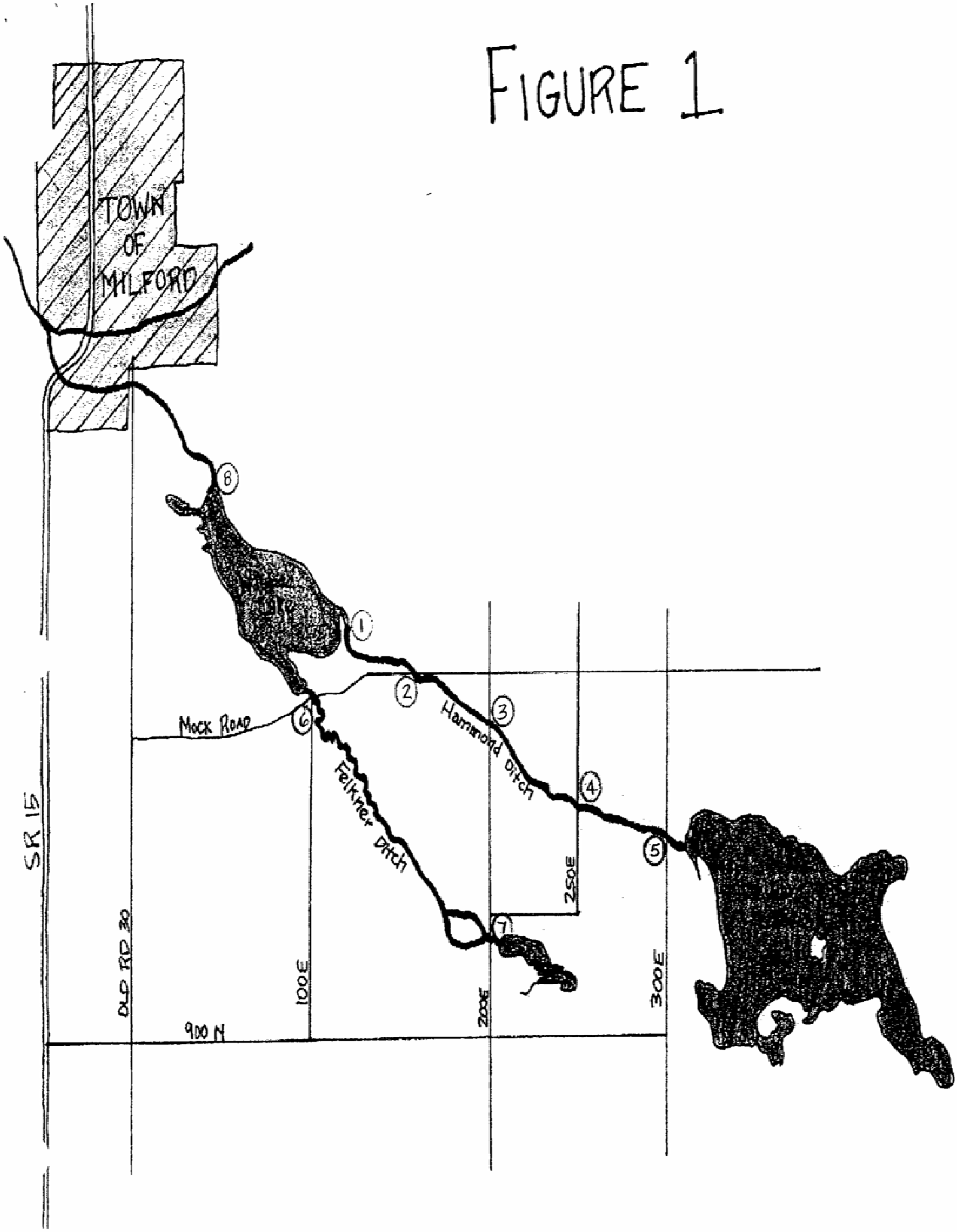
TOWN
OF
MILFORD
8
1
2
3
4
5
6
7
Mock Road
Hammond Ditch
Felkner Ditch
SR 15
OLD RD 30
100E
200E
250E
300E
900 N

Table 1a - Water Testing Results on Samples Taken December 5, 2001

Sites		Phosphate (PO_4)	Nitrate (NO_3)	pH	Clarity
Hammond Ditch	1	Not quite 1 ppm	0-5 ppm, about 2 ppm	8	water was clear
	2	0-1 ppm	0-5 ppm, about 2 ppm	8	water was clear
	3	Less than 1 ppm	1-2 ppm	8	Very clear
	4	Less than 1 ppm	less than 1 ppm	8	Very clear
	5	Less than 1 ppm	less than 1 ppm	8	Very clear
Felkner Ditch	6	1-2 ppm	5 ppm	8	very clear, small trace of duckweed
	7	4 ppm	less than 1 ppm	8	clear, buts lots of mucky suspended solids

Table 1b - Water Testing Results on Samples Taken February 21, 2002

Sites		Phosphate (PO_4)	Nitrate (NO_3)	pH	Clarity
Hammond Ditch	1	Less than 1 ppm	under 5 ppm, about 4	8-9	clear
	2	Less than 1 ppm	under 5 ppm, about 4	8-9	very clear
	3	Less than 1 ppm	0-5 ppm, approx. 2	8-9	clear
	4	0 ppm	0-1 ppm	8-9	clear
	5	0 ppm	0 ppm	8-9	clear, flowing fast
Felkner Ditch	6	Less than 1 ppm	not quite 20 ppm	8-9	clear, very small trace of duckweed
	7	3 ppm	just over 5 ppm	8-9	clear, mucky bottom

Table 1c - Water Testing Results on Sample Taken February 25, 2002

Sites		Phosphate (PO_4)	Nitrate (NO_3)	pH	Clarity
[redacted]	8	Less than 1 ppm	approximately 4 ppm or less	8-9	clear, critters were seen swimming in sample water

Table 1d - Water Testing Results on Samples Taken May 2, 2002

Sites		Phosphate (PO_4)	Nitrate (NO_3)	pH	Clarity
Hammond Ditch	1	0-1 ppm	0-5 ppm, approx. 3	8-9	clear
	2	0-1 ppm	0-5 ppm, approx. 3	8-9	clear
	3	Less than 1 ppm	1 ppm	8-9	clear
	4	Less than 1 ppm	0 ppm	8-9	clear
	5	Less than 1 ppm	0 ppm	8-9	clear
Felkner Ditch	6	0-1 ppm	less than 20 ppm, approximately 15 ppm	8-9	clear, small amount of duckweed
	7	3 ppm	approximately 2 ppm	8-9	clear, mucky bottom
[redacted]	8	Less than 1 ppm	approximately 4 ppm	8-9	clear

Phosphorus is an essential nutrient needed for plant and animal growth, and it is naturally present in the environment and in the soil. It occurs in waters in the form of phosphates (PO_4). The sources of phosphorus and its problems in water are important to understand. Phosphorus problems do not arise from its natural presence, but rather from the addition of excess amounts of phosphorus. When phosphorus is carried to aquatic systems, it increases aquatic plant growth, and if the levels of phosphorus are too high, it can set off a chain of undesirable events such as algal blooms, creating water quality concerns. Once the aquatic plants begin to die, they deplete the dissolved oxygen supply in the water, which can cause fish kills, and nutrients like phosphorus and nitrogen are released from the decomposing plants back into the water, causing a nutrient overload. The reaction of the aquatic system to an overloading of nutrients is known as eutrophication.

Sources of phosphorus include organic matter, lawn and crop fertilizers, human and animal waste, yard wastes-leaves and grass, resuspension of bottom sediments, and through soil erosion. Because phosphorus binds itself to soil particles, soil erosion can be a large source of phosphorus. Phosphate levels higher than 0.03 ppm (mg/L) contribute to increase aquatic plant growth.

Nitrogen is also an essential nutrient found in all living things. It occurs in water as Nitrate (NO_3), Nitrite (NO_2), and Ammonia (NH_3). Nitrate is an oxidized form of Nitrogen (N), Nitrite is the intermediate oxidation state of N, and Ammonia is a form of N that is converted from nitrate by algae. Ammonia is the preferred form utilized by algae, and is also a byproduct of decomposition. In high concentrations, nitrogen can inhibit some plant and animal growth and promote or increase aquatic plant growth, such as blue-green algae blooms. It works with phosphorus to increase algae growth and cause eutrophication.

Sources of nitrogen in water include stormwater runoff, lawn and crop fertilizers, decomposing organic matter, human and animal waste, industrial discharge, and wastewater/sewage from treatment plant effluents. Nitrate is the form of nitrogen that is usually tested, and unpolluted waters generally have a nitrate level below 4 ppm (mg/L). Nitrate levels above 40 ppm (mg/L) are considered unsafe for drinking water.

The **pH** test is one of the most common analyses in water testing. It is a measure of hydrogen ions in the water, and indicates if the water is acidic, neutral, or basic (alkaline). There are a couple of reasons for the importance of pH in water (1) many biological processes such as reproduction cannot occur in highly acidic or basic conditions, and (2) Extremely acidic conditions can lead to the release of toxic chemicals stored in stream sediments.

There are several things that can cause the pH of water to change. Algal blooms and vegetation remove carbon dioxide from the water during photosynthesis, thus causing pH to increase making it more basic. Higher temperatures in the water can lower pH values, making it more acidic. Natural sources such as bogs and acid seeps, and fens can alter the pH. Freshly fallen rainwater, 'Acid Rain', can lower pH values as well. The pH scale ranges from 0 to 14. In order for aquatic organisms to survive, pH should range between 6 and 9. Neutral pH is 7. pH lower than 7 is acidic, and a pH higher than 7 is alkaline.

Ditches and Adjacent Landuse

The ditch and landuse inventory was done in November and December of 2001 to identify any erosion and/or nutrient problems, water quality concerns, and to identify the need for conservation practices. This was accomplished by walking both sides of the ditch and mapping and documenting any areas of concerns. This consisted of looking for cropland erosion, streambank erosion, livestock and wildlife concerns, and current landuse adjacent to the ditch.

Hammond Ditch

The Hammond Ditch mostly flows through agricultural land. The lower part flows through woodlands and then wetlands. Following is a list of the findings during the ditch inventory.

- Along the entire length of the Hammond Ditch, no significant erosion was found.
- The stream channel itself had no visible erosion or sedimentation and appeared to be stabilized.
- There are no domestic animals/livestock adjacent to the ditch.
- There is a Riparian/wooded buffer area along the majority of the stream.
- Hammond ditch flows from Dewart Lake, allowing Dewart Lake to act as a sediment trap for the stream and for Waubee Lake.

- Area through agricultural land

- With the exception of a few small slumps in the muck soils, the ditch banks were stabilized.
- There is a waterway and rock chute near CR 300 E that drains into Hammond Ditch. Both the waterway and rock chute were stabilized.
- There were some areas of overbank flow, but no visible erosion.

- The first ½ mile of the ditch had no filter strip and was cropped up to the edge of the ditch bank. It was flat along the ditch, so there would not be a lot of flow going into it.
- Most of the crop fields were utilizing no-till corn and beans, with one field being fall chiseled.
- The streambank and streambed at the culvert on 200 E was sand and gravel and did not seem to have any sediment deposits.
- There is a small wetland on the south side of Mock Rd that the stream flows through before it enters the woodland. It acts as a good filter for the stream.
- The stream was very clear at the culvert on Mock Rd.

-Wooded area

- The woodland just north of Mock Rd is an old grazed wooded area. For several years, this area was used to graze cattle and was causing some erosion, sedimentation, and nutrient problems in the stream. However, this area is no longer used for grazing, and is now stabilized. There appears to be no visible erosion or sedimentation problems.

-Wetland area

- The last ¼ mile or so before Hammond ditch outlets at Waubee Lake is an overgrown wetland area. This allows the area to be well stabilized and helps to filter the water.

Felkner Ditch

The Felkner ditch begins at the outlet of Maple Leaf Duck Farms animal waste treatment ponds. It flows about 2 miles through a marshy wetland before it enters Waubee Lake. Following is a list of the findings during the ditch inventory.

- The stream channel itself had no visible erosion or sedimentation and appeared to be stabilized.
- There are no domestic animals/livestock adjacent to the ditch.
- There were several springs found along Felkner ditch.
- The first mile or so of the ditch has a defined channel flowing through the wetland. It is a very good buffer and filter area for the stream. Next to the wetland is a large woodland on the both sides of the ditch. Then surrounding the wetland and woodland is agricultural land.
- The cropland on the north side of the ditch was no-tilled. The cropland on the south side of the ditch was both no-tilled and chiseled.
- On the north side of the ditch, there is very little drainage from the cropland. Most surface water flows away from the ditch.
- There was minimum cropland erosion. There were a couple of large gullys on the steep slopes in the woods facing the south side of the stream, and there were several small rills in the cropland facing the woods.
- Irrigation ponds were found on both sides of the ditch. They appeared to be man-made ponds.
- An animal waste management concern was found that may be causing some nutrient problems. The SWCD office is presently working with the landowner to address these concerns and apply conservation practices along the wooded wetland.
- The last mile or so of the ditch flows through a large flooded woodland and wetland before entering the lake. Some areas were difficult to walk and see.
- The last part of the stream is flooded from beaver activity and is so overgrown that in some places there is no longer a defined channel.

Concerns and Recommendations

Based on the findings of the adjacent land use and ditch inventory that was conducted, the following information is what we believe is happening and also lists some recommendations on what can be done to address these situations. There were no major concerns found that would be the source of water quality problems in Waubee Lake.

According to the findings during the inventory, it is possible that nutrients from fertilizers and animal waste are entering the ditch from agricultural land. We recommend installing filter strips to provide an additional buffer along the stream, allowing the stream to be protected from runoff and from overspray of chemicals and fertilizers in the cropland. It is also possible that nutrient runoff is occurring from lawns and garden areas around the lake. It is important to follow all application rates and guidelines, and to leave an untreated buffer area adjacent to the lake.

Most of the cropland was no-tilled, however there were a few areas that were chiseled. The chiseled fields had some gullys, but the riparian buffer on Hammond ditch, and the woodland and wetland on Felkner ditch serve as good buffers from the agricultural land for the streams. Due to this, the tillage did not appear to cause any problems. Recommendation is to work with the landowner to maintain a higher-level of conservation tillage and to install appropriate buffers.

Even though there was erosion taking place in the woodland on the south side of Felkner ditch, the area flattened out and the sediment was being filtered out through the wetlands before it even reached the stream. This area could be monitored to insure that it does not begin to affect the water quality of the stream.

The wetland at the lower end of both ditches consists of woodland and wetland plants that provide filtering of sediments and nutrient uptake from the flowing water. This is achieved by slowing the flow of the water and then the plants can utilize the nutrients in their growth. However, as the plants begin to decompose, they will release the nutrients back into the water. At times, the release of nutrients from the decomposing materials can be higher than the amount of filtering and uptake that the living plants can accomplish. Based on the water quality testing results, this appears to be what is happening with this wetland. The over abundance of vegetation is a concern for causing nutrient problems in the streams and lake. However, it may not be significant enough to cause a major problem to the water quality of Waubee Lake. A detailed, more in-depth study of the relationship between the wetland plants, the decomposing materials, the nutrient levels and their affect to the water quality of Waubee Lake would be needed to determine the impact of the vegetation in the wetland.

Based on the water quality testing, the area below the waste water treatment ponds at Maple Leaf Duck Farms seems to be relatively comparable to the other sites tested.

The majority of the lake is surrounded by muck soils. Muck soils are found around natural lakes and wetlands, and this type of soil can be unstable. There are some homes around Waubee Lake that are built on muck soil. Overtime, the weight from the homes and from fill material placed on top of the muck will cause the soils to push up into the lake. This is happening in many Northern Indiana lakes that have been developed on muck soils. It will appear that the lake is filling in with sediment, when actually it is the muck soil slowly filling in from the bottom. This may be most noticeable in channels that have fill and houses on both sides. This material can be removed from the lake and channel (permits would be required). However, over time the same thing will happen again.

Summary

Since the study that was done in 1982, the water quality of Waubee Lake has greatly improved. In general, the land use adjacent to Hammond and Felkner ditches is not contributing to major water quality problems of the lake.

Local conservation staff could visit with landowners in the watershed to inform them of the current volunteer conservation programs that are available. Also, an additional more in-depth study of the wetlands and their impact to the water quality of the lake may be needed.

APPENDIX A

Conservation Practices

Conservation Tillage: No till and mulch till, both of which leave crop residue on the surface to provide protective cover over the soil, preventing sheet and rill erosion. Farmers in some areas of the state have been more receptive to the practices than others, and producers are more apt to no till soybeans than corn.

Cover Crop: Erosion control can be enhanced with off-season cover crops on fields not having sufficient crop residue. A secondary benefit is that commercial nitrogen fertilizer usage can be reduced since leguminous cover crops add nitrogen to the soil and non-leguminous cover crops can return nitrogen to the soil as they decompose.

Critical Area Planting: This practice provides for the planting of vegetation such as trees, shrubs, grass, or legumes on highly or critically eroding areas; it could also be applied to a problem such as a wet seep on a hillside, and could involve a buffer around a wetland. Erosion is generally reduced by protecting steep slopes or highly erodible soils.

Filter Strip: A vegetated buffer can trap eroded soil and stormwater-borne nutrients and pesticides which might otherwise be transported down slope into surface waters. This practice can be extremely beneficial in affording protection where other measures may not be practicable. Filter strips can also supplement practices which may not, themselves, be fully satisfactory for protecting water bodies from agricultural pollutants. For example, even though conservation tillage can reduce erosion on a crop field, a certain amount of soil can still be eroded from the field -- but could be trapped by a filter strip. The effectiveness of filter strips is influenced by factors such as width, slope, vegetation type, sediment particle size, and runoff rate.

Grade Stabilization Structure: In areas where the concentration and flow velocity of runoff is sufficiently high, an engineered structure such as a rock chute or block chute is required to control the grade and head-cutting of natural or artificial channels, thereby preventing the advancement or formation of gullies.

Grassed Waterway: Grassy vegetation in an area of concentrated flow can greatly reduce erosion. A grassed waterway is typically a constructed shallow channel that is shaped and vegetated to provide for stable conveyance of runoff.

Streambank Protection: Vegetation and/or structures can be effectively used to stabilize and protect the banks of streams or channels from scour and erosion. This reduces sediment loads that cause downstream damages and pollution, and can also improve the stream for recreation and as habitat for fish and wildlife. Some projects may require regulatory permits from IDNR or the Corps of Engineers, which should be ascertained prior to construction.

Tree Planting: Establishing a stand of trees can control erosion, conserve soil, and retain moisture. This can aid in flood reduction, sedimentation control, and wildlife habitat improvement. Water quality benefits can be derived from plantings adjacent to streams which provide shade and act as a food source, and reduce streambank erosion. Mature trees can also serve as barriers to erosion-causing winds. Professional assistance regarding species selection and planting regimes can be solicited from IDNR district foresters, and is encouraged.

Waste Management System and Waste Utilization: Livestock waste must be properly managed, from both economic and environmental perspectives. A planned management system is a means of assuring proper storage and/or usage of the manure. A well designed system prevents or minimizes degradation of air, soil, and water resources and protects public health and safety. Systems prevent discharge of pollutants to surface or ground water and allow the waste to be recycled through soil and plants. A waste management system allows for more effective utilization of animal waste and minimizes nutrient and bacteria levels in runoff from barnyards and feedlots. An appropriately sized storage lagoon or waste pit allows producers to spread and incorporate the manure when conditions are ideal, e.g., during peak crop nutrient demand periods, thus reducing commercial fertilizer costs. A proper system must include an environmentally acceptable strategy for utilizing the waste.

APPENDIX B

Agencies

Soil and Water Conservation District (SWCD) – SWCDs are subdivisions of state government led by a 5 member board of supervisors. SWCDs determine and address the natural resource needs in their counties, and develop and carry out soil and water conservation programs within its county boundaries. In this way, they work closely with local people. Indiana's conservation districts are structured for local leadership. Committees at all levels address natural resource education, forestry, and wildlife, soil and water resources, district operations, marketing, ways and means, and legislative issues.

IDNR, Division of Soil Conservation – The Division of Soil Conservation is established within the Indiana Department of Natural Resources, and works to provide technical, educational, and financial assistance to citizens in order to solve erosion and sediment-related problems occurring on the land or impacting public waters. The Division directly assists the 92 Soil and Water Conservation Districts in fulfilling their legal mandate to protect the state's land and water resources.
The Division of Soil Conservation belongs to the Indiana Conservation Partnership. The partnership includes Indiana's 92 soil and water conservation districts (SWCDs), the USDA Natural Resources Conservation Service, and the Purdue University Cooperative Extension Service.

USDA, Natural Resources Conservation Service (NRCS) – NRCS is a federal agency that administers federal conservation programs, and also works hand-in-hand with land users to conserve natural resources on private lands. They are committed to providing high quality technical assistance, conservation planning and program information support to private land users. NRCS also helps the Soil and Water Conservation Districts achieve the objectives set forth in their long-range plan by providing part of the personnel, equipment, technical assistance and office space to the Districts.

APPENDIX C

Glossary

acidic – having a pH lower than 7 (e.g. lemon juice, battery acid, cola, vinegar)

algae – small plants which lack roots, stems, flowers, and leaves; living mainly in water and using the sun as an energy source

algal blooms – a sudden growth of algae caused by an excess of nutrients

animal waste treatment lagoon – an impoundment made by excavation or earth fill for biological treatment of animal or other agricultural waste

aquatic – plants and/or animal life living or growing in or on the water

basic – having a pH higher than 7 Also known as alkaline (e.g. baking soda, ammonia, bleach, lye)

best management practices – the management of conservation practices best suited for the landscape to protect water quality and other natural resources

bog – a specific kind of wetland/marsh characterized by low pH (acidic) and unique vegetation conservation practice – an engineered structure or management activity that eliminates or reduces an adverse environmental effect of a pollutant and conserves soil, water, plant, air, or animal resources

decomposition (decomposing) – the decay of organic matter

deplete – to reduce or lessen in quantity, value, or effectiveness

dissolved oxygen – the amount of oxygen dissolved in water. Generally, proportionately higher amounts of oxygen can be dissolved in colder waters than in warmer waters

duckweed – small, free-floating, stemless aquatic plants

erosion – the wearing away of the land surface by wind or water

eutrophication – the nutrient overload of a water body, causing a decrease in dissolved oxygen and an increase on aquatic plan growth

fen – a specific find of wetland/marsh characterized by high pH (alkaline) and unique vegetation

loading – the quantity of a pollutant entering the water

neutral – having a pH of 7, being neither acidic nor basic

nitrogen – an essential nutrient found in all living things. In water, in high concentration, it can cause large algal blooms and deplete oxygen in the water nutrient – any chemical substance which is necessary for growth of living things

pH – the measure of hydrogen ions in the water, indicates if the water is acidic, neutral, or basic. The pH scale ranges from 0-14.

phosphorus – an essential nutrient needed for plant and animal growth. Its presence is natural in the environment and in the soil, but in excessive quantities, it can contribute to eutrophication.

photosynthesis – process by which plants use sunlight to produce food

ppm – parts per million

riparian buffer – an area, adjacent to and along a watercourse, which is often vegetated and constitutes a buffer zone between the nearby lands and the watercourse

runoff – water from rain, snowmelt, or irrigation that flows over the ground surface and runs into a water body

sediment – soil, sand, and minerals washed from land into waterways

sedimentation – the process by which soil particles (sediment) enter, accumulate and settle to the bottom of a waterbody

streambed – the bottom of a stream where the substrate and sediments lay tributary – a smaller stream flowing into a larger stream, river, or lake

water quality – the condition of the water with regard to the presence or absence of pollution

watershed – The entire surface drainage area that contributes water to a stream or river or lake. Many watersheds which drain into a common river or lake make a drainage basin.

APPENDIX D

References

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